

(12) **UK Patent Application** (19) **GB** (11) **2 275 284** (13) **A**

(43) Date of A Publication 24.08.1994

(21) Application No 9403276.0

(22) Date of Filing 21.02.1994

(30) Priority Data

(31) 9303325 (32) 19.02.1993 (33) GB

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(52) UK CL (Edition M)

**E1F FAC FAC5**

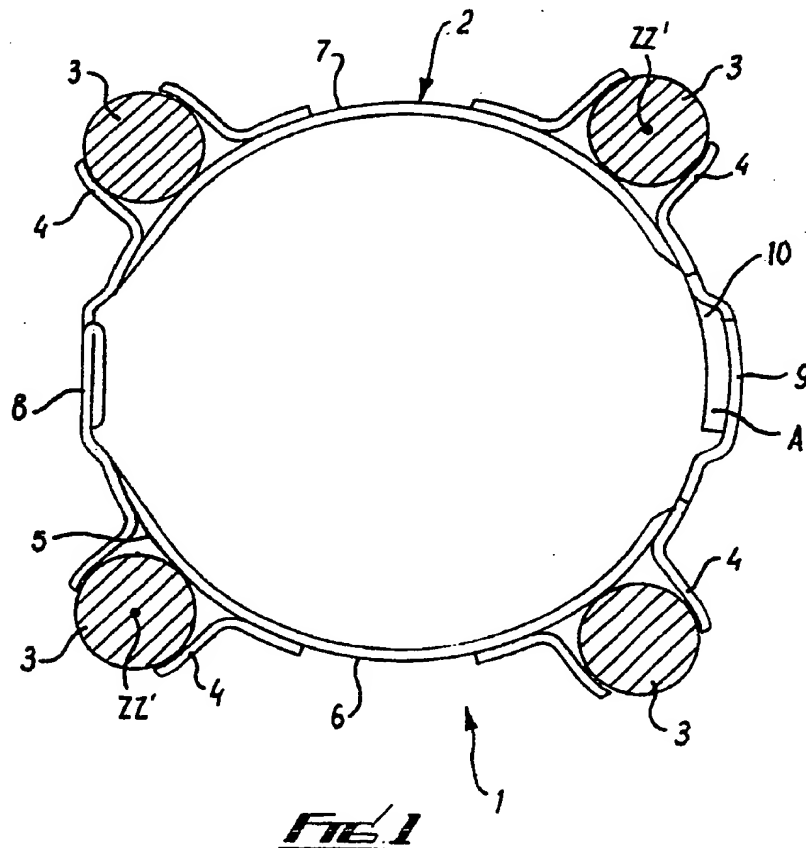
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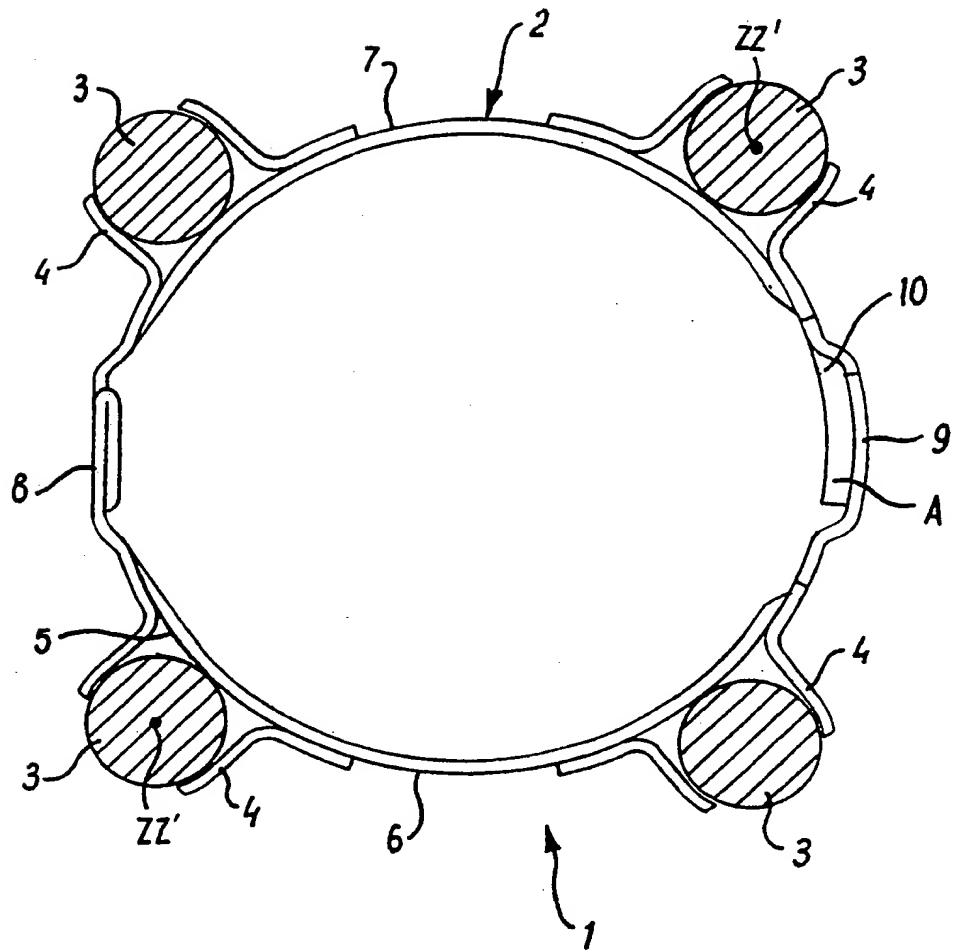
(58) Field of Search

**UK CL (Edition M) E1F FAC****INT CL<sup>5</sup> E21B**(54) **Drill pipe protector**

(57) A protector 1 for a drill-pipe in a borehole has a body member 2 in two parts 6, 7 to be clamped around the drill-pipe, and friction-reducing means 3 extending beyond the outer surface of the body member so as to touch the inside wall of a cylindrical pipe or casing within which the drill-pipe is located. The friction reducing means may be spherical or cylindrical or elliptical rollers 3, or spherical or toroidal members (not shown) made of low friction material.

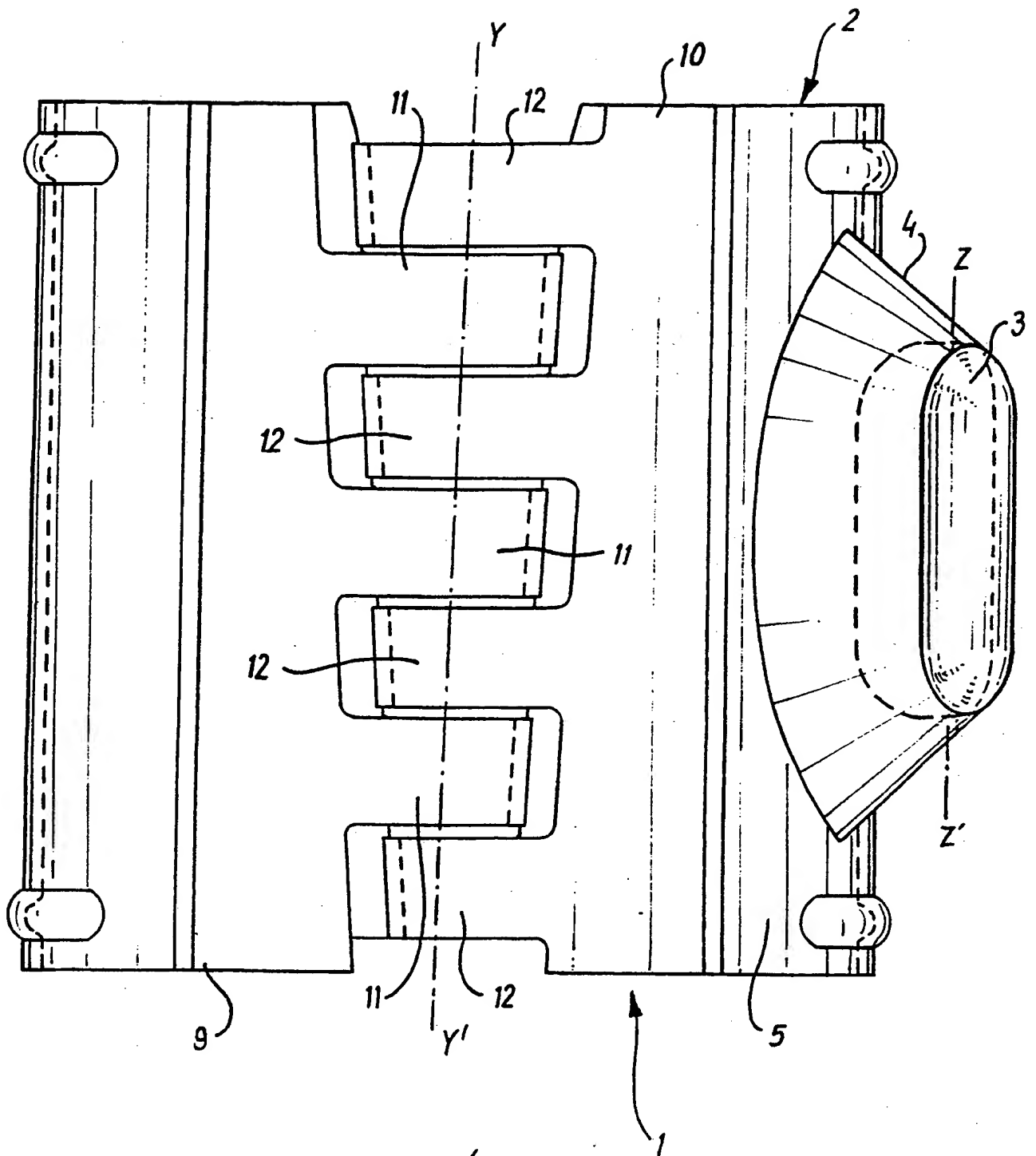
**FIG. 1**

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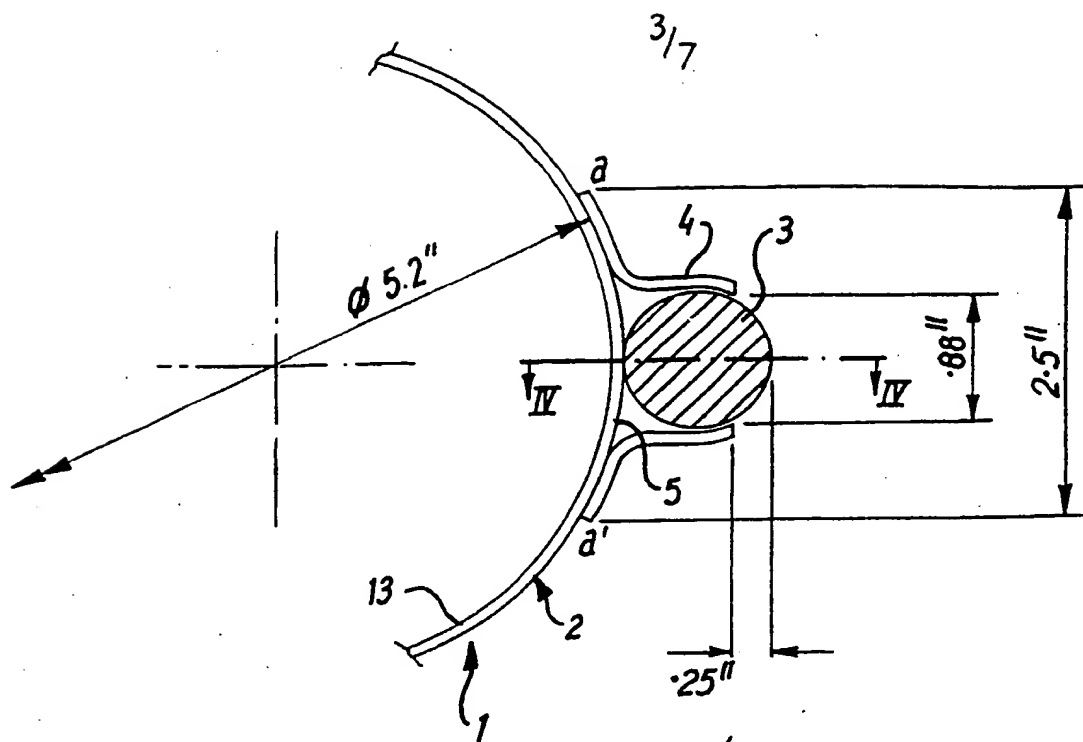


**FIG. 1**

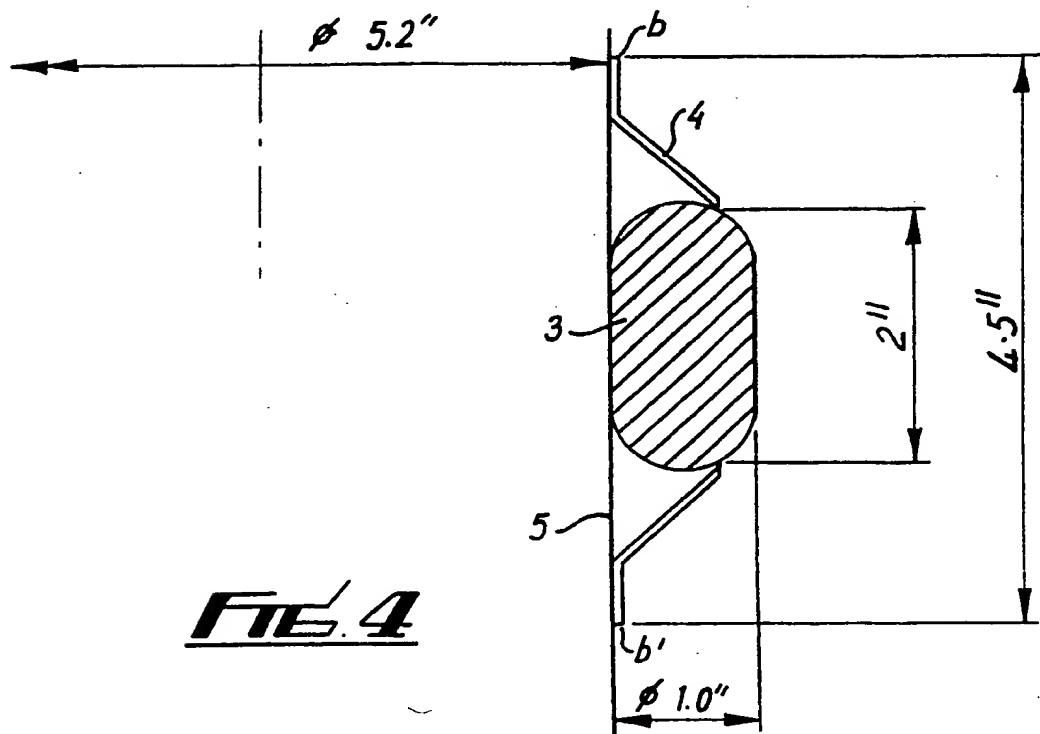
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**FIG. 2**



**FIG. 3**



**FIG. 4**

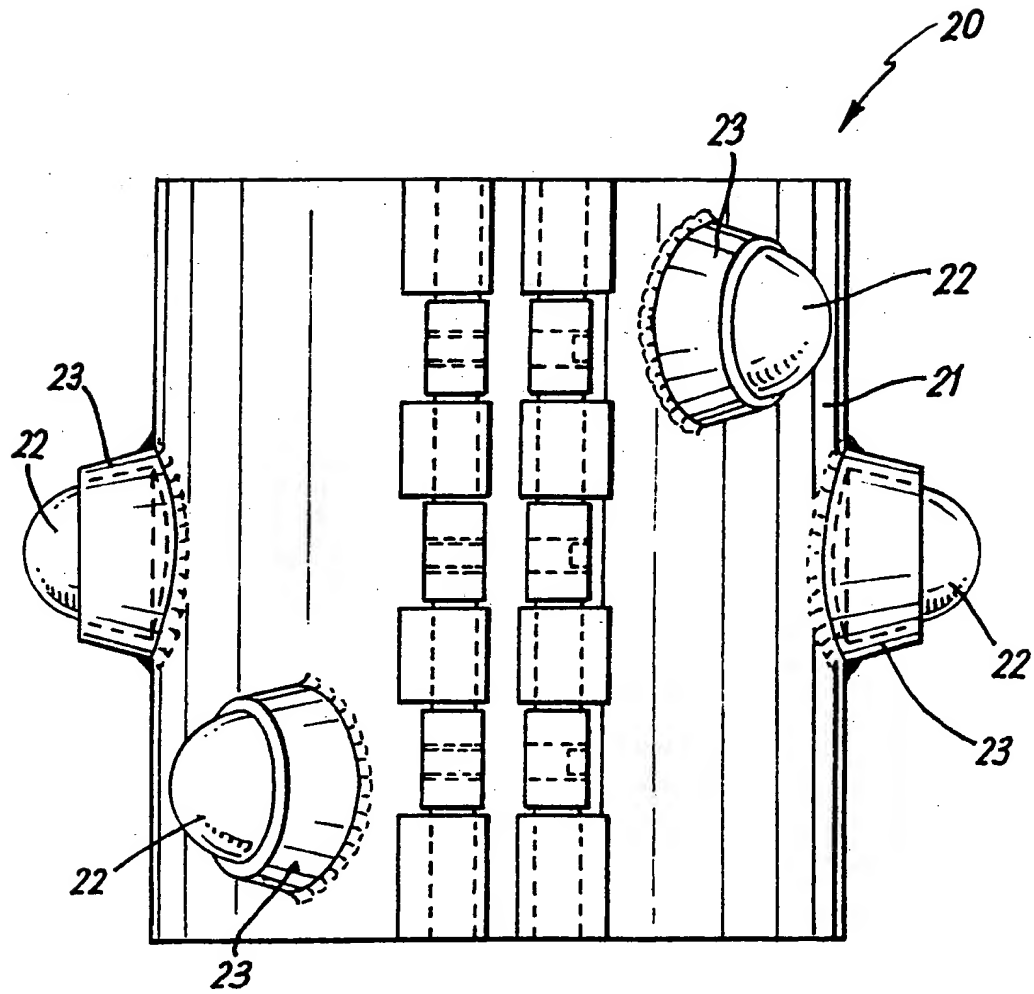
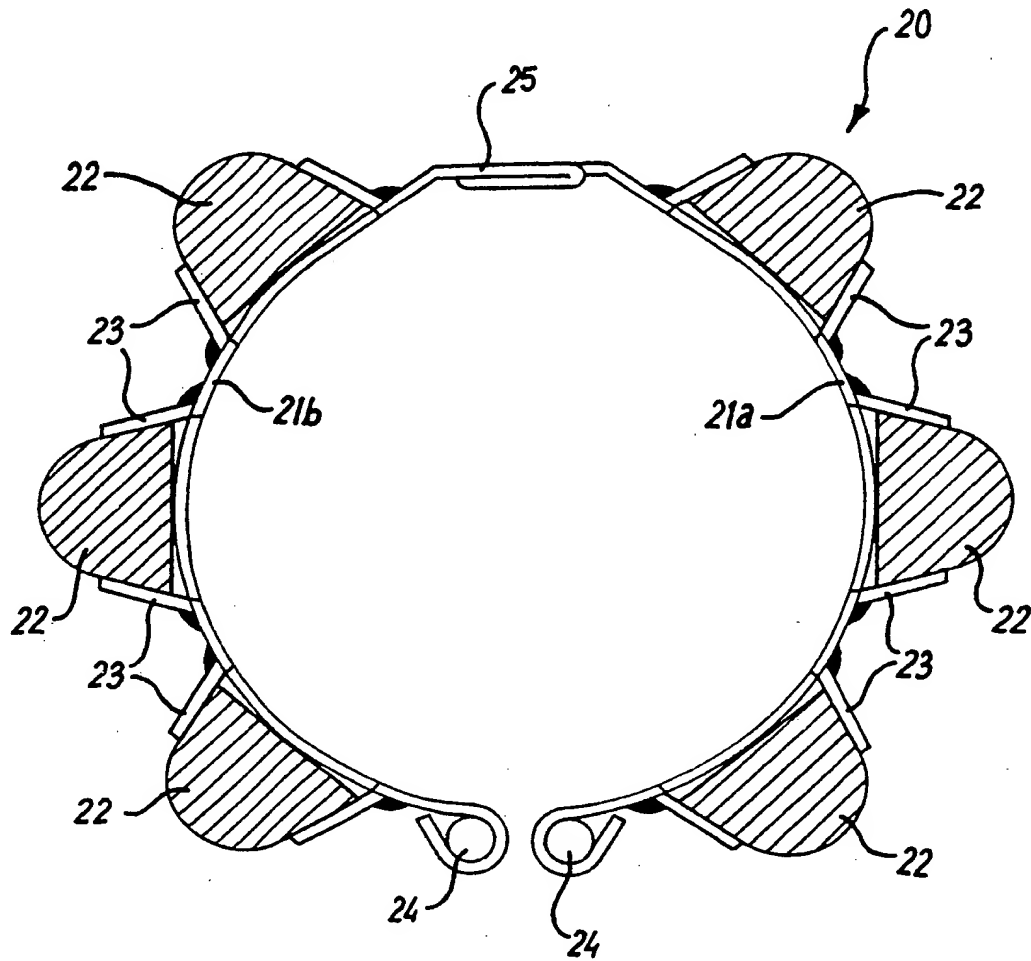
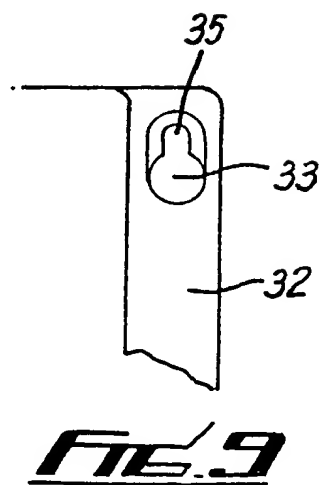
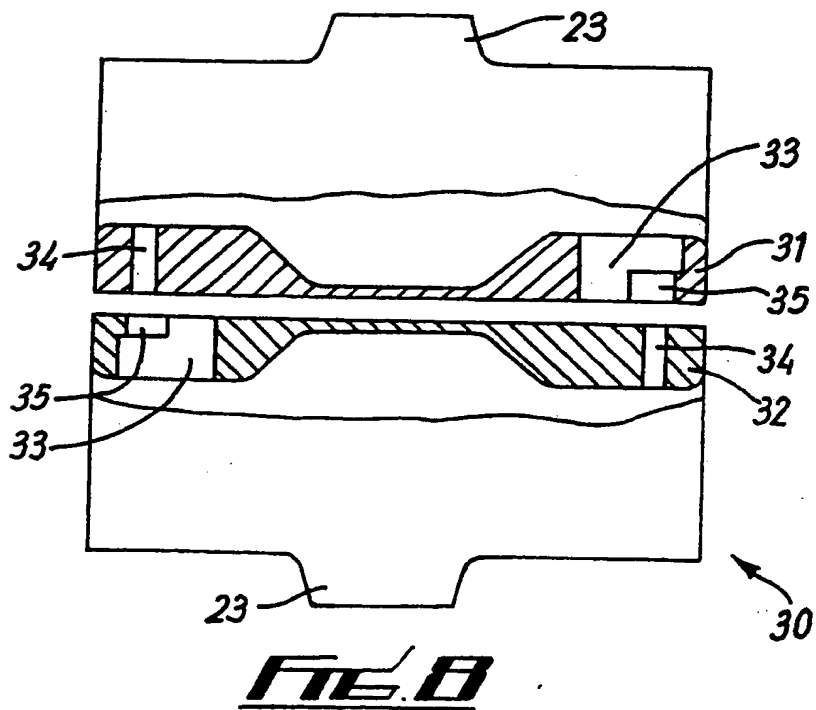
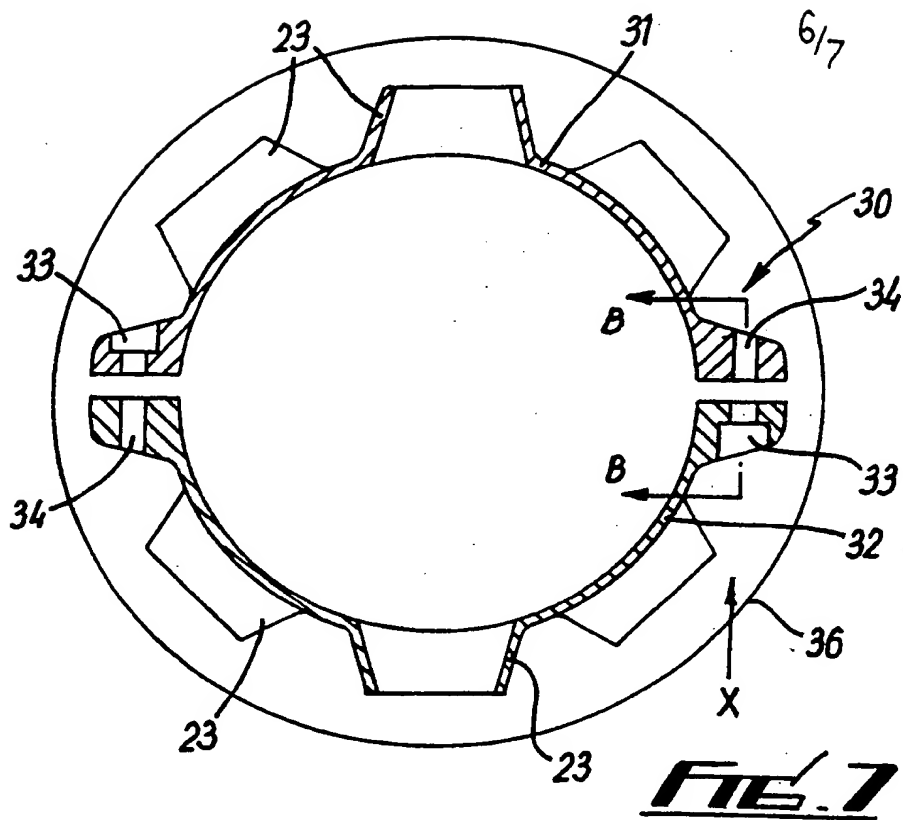
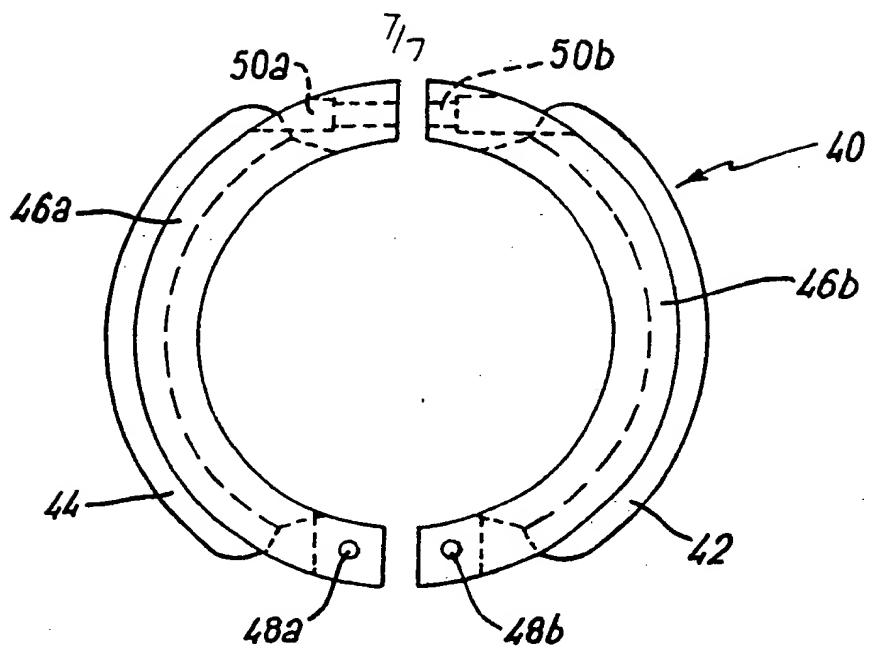


FIG. 5

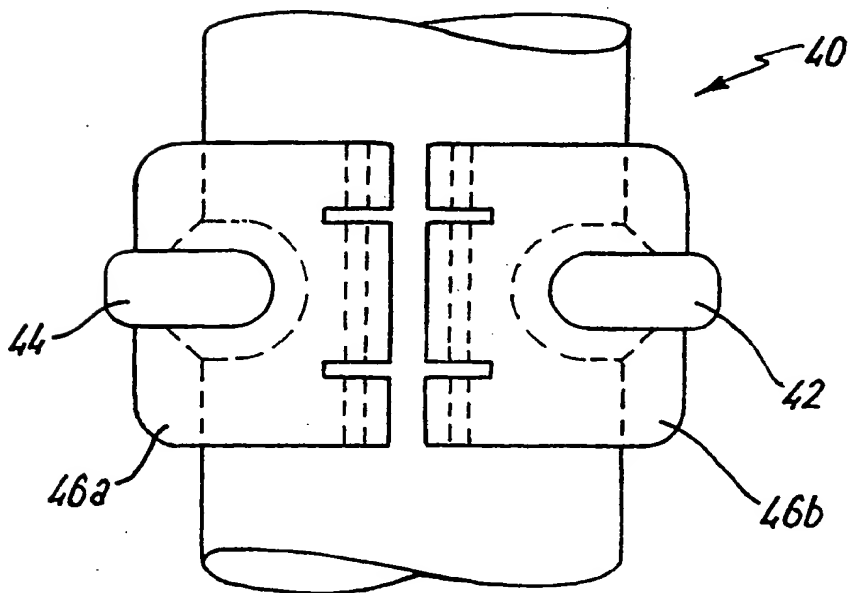


**FIG. 6**





**FIG. 10**



**FIG. 11**



1

1     "A Protector"

2

3     This invention relates to a protector for a tubular  
4     member in a borehole and in particular, but not  
5     exclusively, a drill-pipe protector.

6

7     When drilling boreholes, such as for oil and gas, it is  
8     necessary to maintain constant rotation of the drill-  
9     bit which in the case of rotary drilling involves  
10    rotation of drill-pipe. In order to replace the drill-  
11    bit the drill-pipe is also required to be removed from  
12    the borehole. This frequent movement in and out of the  
13    borehole together with the rotation in the borehole  
14    frequently results in damage to the drill-pipe and/or  
15    casing lining the borehole.

16

17    In order to prevent or at least to reduce the amount of  
18    damage, protectors are clamped around the drill-pipe.  
19    Conventional protectors are made from rubber which  
20    contain an internal steel case to provide grip.

21

22    However, these rubber protectors have several  
23    disadvantages. The use of the rubber protectors is  
24    limited to conditions where the temperature is below  
25    about 250°F. In view of this, these conventional

1 protectors would be unsuitable for use in geothermal  
2 drilling applications where the temperature may be as  
3 high as 500 to 600°F.

4  
5 In addition, during the drilling procedure, muds are  
6 utilised for lubrication and for removal of waste  
7 material. However, conventional rubber drill-pipe  
8 protectors are prone to attack by oil-based drilling  
9 muds which cause swelling and a reduction in physical  
10 properties leading to premature wear.

11  
12 A further disadvantage of the conventional rubber  
13 drill-pipe protector is that in the event of a gas kick  
14 into the well bore, gas may penetrate the rubber such  
15 that when the drill-pipe and protector are withdrawn  
16 from the borehole, the gas expands and causes  
17 blistering of the rubber.

18  
19 An additional disadvantage is that there is not a high  
20 gripping force between the rubber drill-pipe protector  
21 and the metal drill-pipe such that the drill-pipe  
22 protector may slip during drilling, particularly if the  
23 operator has not fitted the protector correctly.

24  
25 In the drilling operation, torque is applied to the  
26 drill-pipe, and it is desirable to reduce friction  
27 between the rotating drill-pipe and borehole to  
28 minimise the torque required to rotate the drill-pipe.  
29 Conventional rubber drill-pipe protectors can increase  
30 this friction, which is undesirable.

31  
32 In accordance with the present invention there is  
33 provided a protector for a tubular member in a  
34 borehole, the protector comprising a body member  
35 adapted to be fitted to said tubular member, and

1 friction reducing means mounted on the body member, and  
2 a surface of the friction reducing means extending  
3 beyond the outer surface of the body member and the  
4 tubular member.

5  
6 In one example of the invention the friction reducing  
7 means may comprise a friction reducing member mounted  
8 on the body member, the surface being formed from a  
9 material having a low coefficient of friction. The  
10 surface may be part-spherical or part-toroidal, and  
11 there may be a plurality of such surfaces. The  
12 friction reducing member could be formed from a low  
13 friction coefficient material or could be formed from a  
14 low friction coefficient coating on a base material.

15  
16 In another example of the invention the friction  
17 reducing means may comprise a rotation member, the axis  
18 of the rotation member being substantially parallel to  
19 the longitudinal axis of the body member, and the  
20 rotating surface of the rotation member extending  
21 beyond the outer surface of the body member and the  
22 tubular member.

23  
24 Preferably, the body member includes more than one  
25 rotation member, each rotation member being rotatably  
26 mounted on the body member. Typically, the body member  
27 includes three or more rotation members and preferably  
28 includes four rotation members.

29  
30 Typically, the rotation member is generally ellipsoidal  
31 or cylindrical in shape. Alternatively, spherical  
32 balls may be employed as rotation members. However, in  
33 the preferred embodiment the rotation member is a  
34 roller rotatably mounted on the external surface of the  
35 body member.

1 Preferably, the friction reducing member or the  
2 rotation member is made from a low friction coefficient  
3 material such as polytetrafluoroethylene (PTFE),  
4 ceramics, steel, an alloy, or any other suitable  
5 material.

6  
7 Preferably, the body member is made from a durable  
8 material, such as metal.

9  
10 Preferably, the body member is in the form of a collar  
11 adapted to be closed around the tubular member. The  
12 tubular member may be, for example, a drill-pipe.

13  
14 Typically, the rotation member is located within a  
15 housing on the external surface of the body member.

16  
17 Preferably, the housing located on the external surface  
18 of the body member is made from the same material as  
19 the body member. Typically, the housing is attached to  
20 the body member by, for example, welding or rivetting.

21  
22 Most preferably, the body member comprises first and  
23 second generally semi-cylindrical members pivotably  
24 connected to one another, at least one rotation member  
25 being located within a housing on the external surface  
26 of at least one of said members, such that when the  
27 body member is closed around the tubular member an end  
28 of the first member engages with an end of the second  
29 member. Preferably also, the body member is locked in  
30 position by a removable locking member.

31  
32 A suitable locking member may be, for example, a  
33 tapered locking pin which extends longitudinally  
34 through apertures in the first and second ends of the  
35 body member. Alternatively a suitable locking member

1 may be, for example, a bolt and flange.

2

3 Examples of a protector in accordance with the  
4 invention will now be described with reference to the  
5 accompanying drawings, in which:-

6

7 Fig. 1 is a cross-sectional view of a first  
8 example of a drill-pipe protector;

9 Fig. 2 is a side view of the drill-pipe protector  
10 shown in Fig. 1;

11 Fig. 3 is a cross-sectional view of the drill-pipe  
12 protectors shown in Figs. 1 and 2;

13 Fig. 4 is a sectional view on line IV-IV of Fig.  
14 3;

15 Fig. 5 is a side view of a second example of a  
16 drill-pipe protector;

17 Fig. 6 is a cross-sectional view through the  
18 protector shown in Fig. 5;

19 Fig. 7 is a cross-sectional view through a third  
20 example of a drill-pipe protector with friction  
21 reducing members removed;

22 Fig. 8 is a sectional view along the line BB of  
23 Fig. 7;

24 Fig. 9 is a view along the arrow X in Fig. 7; and,  
25 Fig. 10 is a plan view and Fig. 11 is an elevation  
26 of a fourth example of a drill-pipe protector.

27

28 Fig. 1 shows a cross-sectional view of a generally  
29 cylindrical drill-pipe protector 1 in the form of a  
30 collar 2 with rollers 3 located inside housings 4 on  
31 the external surface 5 of the collar 2. Each roller 3  
32 is cylindrical in shape with hemi-spherical ends and is  
33 free to rotate in both the clockwise or anti-clockwise  
34 directions about their longitudinal axis. The collar 2  
35 comprises first and second generally semi-cylindrical

members 6 and 7, hingeably connected to one another by a hinge mechanism 8 such that the collar 2 may be closed around a drill-pipe (not shown). In the closed position as shown in Fig. 1, an end 9 of the first member 6 engages with an end 10 of the second member 7. The collar 2 may be locked in position by insertion of a tapered locking pin (not shown) through apertures formed in inter-engaging formations 11 and 12 on ends 9 and 10 of the members 6 and 7 (see also Fig. 2).

Fig. 2 shows a side view of the drill-pipe protector 1 as shown in Fig. 1. The rollers 3 are partially enclosed within housings 4 secured to the external surface 5 of the collar 2 and are free to rotate around longitudinal axes  $ZZ'$ . In the closed position, elongations 11 of an end 9 of the first member 6 engage in an alternate manner with elongations 12 of an end 10 of the second member 7. The collar 2 may be locked in position by insertion of a tapered locking pin (not shown) through apertures (not shown) in the elongations 11 and 12, along the direction  $YY$ , as previously discussed.

Fig. 3 is a cross-section view of a portion of the drill-pipe protector 1 of Figs. 1 and 2, showing one of the rollers 3 located within its housing 4. The housing 4 is attached to the collar 2 which has an external diameter of about 5.2 inches. The width of the housing 4 at the area of attachment to the external surface 5 of the collar 2, namely between the points  $a$  and  $a'$ , is 2.5 inches. The width of the external aperture in the housing 4 through which the roller 3 partially projects is 0.88 inches. The roller 3 protrudes from the housing 4 by 0.25 inches.

1 A sectional side-view of the roller 3 and housing 4 of  
2 Fig. 3 is shown in Fig. 4, where the length of the  
3 housing 4 taken from the area of attachment to the  
4 external surface 5 of the collar 2, namely between the  
5 points b and b' is 4.5 inches. The length of the  
6 external aperture in the housing 4 in which the roller  
7 3 is contained is 2 inches. The diameter of the roller  
8 3 is 1 inch.

9  
10 The surface of the drill-pipe protector 1 may be  
11 complete as shown in the example above, or it may have  
12 apertures in an area behind the rotation members to  
13 provide an exit for, for example, mud fluid.

14  
15 Figs. 5 and 6 show a second example of a drill-pipe  
16 protector 20 which comprises a collar 21 with a number  
17 of friction reducing members 22 mounted on the surface  
18 of the collar 21 in housings 23. The collar 21  
19 comprises two halves 21a, 21b connected at one side by  
20 a hinge 25 and can be coupled at the other side by a  
21 removable pin (not shown) which pins sections 24  
22 together.

23  
24 The friction reducing members 22 are manufactured from  
25 a relatively low friction coefficient material, such as  
26 polytetrafluoroethylene (PTFE), ceramics, steel, alloy,  
27 or any other suitable material.

28  
29 In use, the protector 20 is used and operates in a  
30 similar manner to the protector 1, with the exception  
31 that the friction reducing members 22 replace the  
32 rollers 3.

33  
34 Figs. 7 to 9 show a third example of a drill-pipe  
35 protector 30. In Figs. 7 and 8, the protector 30 is

1 shown with the friction reducing members removed, but  
2 the protector 30 and the friction reducing members are  
3 the same as that shown in Figs. 5 and 6. The protector  
4 30 differs from the protector 20 in that each half 31,  
5 32 of the protector 30 is identical and the halves 31,  
6 32 are clamped together by means of four bolts (not  
7 shown). The bolts pass through bolt holes 33, 34 on  
8 each end of each half 31, 32. As shown in Figs. 8 and  
9 the bolt holes 33 are "key-hole" shaped to permit the  
10 heads of the bolts (or nuts) to pass through the hole  
11 33 and then engage in slot 35 to retain the halves 31,  
12 32 together.

13

14 The circle 36 in Fig. 7 represents the maximum outside  
15 diameter of the protector with the friction reducing  
16 members fitted. It can be seen that the diameter is  
17 such that when in use within cylindrical pipe or casing  
18 of the same or similar diameter, only the friction  
19 reducing members will touch the inside wall of the pipe  
20 or casing.

21

22 The internal surface of the drill-pipe protectors 1,  
23 20, 30 may include an additional layer such as steel  
24 mesh, which provides enhanced gripping force between  
25 the drill-pipe protector and the drill-pipe.

26

27 Figs. 10 and 11 show a fourth example of a drill-pipe  
28 protector 40 which has a friction reducing member in  
29 the form of a two-part band 42, 44 of generally  
30 toroidal shape projecting beyond the surface of a  
31 collar 46 in two halves 46a, 46b. The halves of the  
32 collar are hinged at hinge points 48a, 48b and can be  
33 bolted together by bolts (not shown) passing through  
34 apertures 50a, 50b in the opposite ends of the halves  
35 from the hinge points.



1 The parts of the band 42, 44 taken together extend  
2 around approximately three quarters of the external  
3 surface of the collar 46 and may be manufactured from a  
4 low friction coefficient material such as  
5 polytetrafluoroethylene (PTFE). As in previous  
6 examples, the external diameter of the band 42, 44 is  
7 such that when in use within a cylindrical pipe or  
8 casing of similar diameter, only the curved surface of  
9 the low-friction band will touch the inside of the pipe  
10 or casing.

11

12 In a variation, two or more toroidally-shaped bands may  
13 be provided at spaced positions.

14

15 The drill-pipe protector of the present invention  
16 provides several advantages over the conventional  
17 drill-pipe protector in that the presence of the  
18 friction reducing members or the rotation members on  
19 the surface of the protector provide a load bearing  
20 surface which helps reduce the torque experienced by  
21 the drill-pipe during the drilling process.

22 Furthermore, the materials from which the protector and  
23 rotation members or friction reducing members are made  
24 are such that they can withstand wide variations of  
25 temperature and pressure and are not sensitive to oil  
26 based mud formulations. In addition, the metal body  
27 member of the protector provides increased gripping  
28 force between the protector and the metal drill-pipe,  
29 which helps to prevent the protector from slipping.

30

31 Improvements and modifications may be incorporated  
32 without departing from the scope of the invention.

33

34

1     CLAIMS

2

3     1.    A protector for a tubular member in a borehole  
4     comprising a body member adapted to be fitted to said  
5     tubular member, and friction reducing means mounted on  
6     the body member, a surface of the friction reducing  
7     means extending beyond the outer surface of the body  
8     member and the tubular member.

9

10    2.    A protector according to claim 1, in which the  
11    friction reducing means comprises a friction reducing  
12    member mounted on the body member, the surface being  
13    formed from a material having a low coefficient of  
14    friction.

15

16    3.    A protector according to claim 2, in which the  
17    friction reducing means is formed from a low friction  
18    coefficient material.

19

20    4.    A protector according to claim 2, in which the  
21    friction reducing means is formed from a base material  
22    coated with a low friction coefficient material.

23

24    5.    A protector according to any of the preceding  
25    claims in which the friction reducing means comprises a  
26    rotation member, the axis of the rotation member being  
27    substantially parallel to the longitudinal axis of the  
28    body member, and the rotating surface of the rotation  
29    member extending beyond the outer surface of the body  
30    member and the tubular member.

31

32    6.    A protector according to claim 5, in which the  
33    body member includes more than one rotation member,  
34    each rotation member being rotatably mounted on the  
35    body member.

1     7.    A protector according to claim 6, in which there  
2     are three or more rotation members.

3

4     8.    A protector according to claim 7, in which there  
5     are four rotation members.

6

7     9.    A protector according to any one of the preceding  
8     claims in which the rotation member is generally  
9     ellipsoidal in shape.

10

11    10.   A protector according to claim 5, in which the  
12    rotation member is generally cylindrical in shape.

13

14    11.   A protector according to claim 5, in which the  
15    rotation member is generally spherical in shape.

16

17    12.   A protector according to claim 5, in which the  
18    rotation member is a roller rotatably mounted on the  
19    external surface of the body member.

20

21    13.   A protector according to claim 1 in which the  
22    friction reducing means is at least one band of low  
23    friction material of toroidal shape.

24

25    14.   A protector according to claim 13, in which the  
26    band of toroidal shape extends around three quarters of  
27    the circumference of the body member.

28

29    15.   A protector according to any one of the preceding  
30    claims in which the body member is in the form of a  
31    collar adapted to be closed around the tubular member.

32

33    16.   A protector according to claim 15 having at least  
34    one rotation member located within a housing on the  
35    external surface of the body member.

1 17. A protector according to any one of the preceding  
2 claims in which the body member comprises first and  
3 second generally semi-cylindrical members pivotably  
4 connected to one another, at least one friction  
5 reducing means being located within a housing on the  
6 external surface of at least one of said member, such  
7 that when the body member is closed around the tubular  
8 member an end of the first member engages with an end  
9 of the second member.

10

11 18. A protector according to any one of the preceding  
12 claims in which the body member is locked in position  
13 by a removable locking member.

14

15 19. A protector for a tubular member in a borehole  
16 substantially as described herein with reference to any  
17 of the accompanying drawings.

18

19

## Relevant Technical Fields

(i) UK Cl (Ed.M) E1F (FAC)

(ii) Int Cl (Ed.5) E21B

Search Examiner  
D J HARRISONDate of completion of Search  
12 MAY 1994

## Databases (see below)

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii)

Documents considered relevant  
following a search in respect of  
Claims :-  
1 TO 19

## Categories of documents

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- A: Document indicating technological background and/or state of the art. &: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2211225 A	(EXXON PRODUCTION RESEARCH COMPANY) whole document, but see particularly page 4 line 16 to page 5 line 5.	1,15,17,18
X	GB 2204895 A	(LLOYD & HERRERA) whole document, but see particularly page 4 line 8 to page 5 line 8	1,2,3,5,10,13,15
X	GB 307212 A	(CUTHILL) whole document	1,5,10
X	GB 271839 A	(US TOOL CO) whole document	1,5,6,7,10,11,12
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X	US 4372622 A	(CHEEK) whole document	1,5,6,7,11

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